High-Frequency Hearing Loss in Male Farmers of Missouri

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SYNOPSIS

Farmers are exposed to noise that is potentially hazardous to hearing. We measured the hearing of 161 male farmers and 75 male nonfarmers at the 1979 Missouri Farmers Association Agri-Fair and compared it with the hearing of 129 office workers from central Missouri. Fixed-level screening tests were conducted in both ears at three stimulus frequencies: 1000 and 2000 hertz at 20 decibels hearing level and 4000 hertz at 25 decibels hearing level. Audiometers were calibrated in accordance with the ANSI–1969 standard.

The results show that farmers are at risk for hearing loss at 2000 and 4000 hertz when compared with office workers. The prevalence of hearing loss was greater for farmers at both frequencies in every decade age group from 25 to 64 years. Using screening failure at 2000 and 4000 hertz in both ears as a criterion for a loss that would affect communication ability, we found that the failure rate was 16.8 percent for farmers and 6.2 percent for office workers. As other investigators have found, the prevalence of high-frequency hearing loss in male nonfarmers who associate with farmers was nearly as great as for farmers.

MANY FARMERS ARE EXPOSED TO NOISE that is potentially damaging to hearing. Some of the sources of high-level noise are tractors (*1–3*), grain dryers, brush hogs, chain saws, and transistor radio sound superimposed on machine noise. The recreational activities of farmers may also be noisy: many farmers are hunters; some own snowmobiles that generate extremely high levels of noise.

Repeated exposure to excessive noise results in permanent damage to the sensory and neural structures of the cochlea. Early damage is typically sustained in the basal turn of the cochlea and affects hearing in the frequency range from 3000 to 6000 hertz (Hz). The maximum loss with early damage is commonly incurred at 4000 Hz. With continued overexposure to noise, the loss increases in degree and extends to lower and higher frequencies. When the loss significantly affects the hearing at 2000 Hz, the ability to understand speech is affected.

Since noise-induced hearing loss is usually acquired over a number of years, its effects are mixed with those of the sensory and neural degeneration of the auditory system due to aging (presbycusis). With aging, there is a progressive loss that occurs gradually in the low frequencies and more rapidly in the high frequencies (*4–8*). Thus, both noise-induced hearing loss and presbycusis have their greatest effect on high-frequency hearing (*8–12*).

Hearing threshold data have been obtained on large samples of male farmers in two studies conducted at fairs in Wisconsin. At the 1954 Wisconsin State Fair, Glorig and associates (*4*) found that farmers in the 50–59 and 60–69 year age groups had significantly more hearing loss over the frequency range from 2000 to 6000 Hz than office workers in the same age categories. We undertook the study described here to reexamine the risk of high-frequency hearing loss for farmers. We were especially interested in determining if the younger farmers were at risk.

While our study was being conducted, Karlovich and co-workers (*13*) were completing a 5-year study on farmers and nonfarmers who attended Farm Progress Days Expositions that are held annually in Wisconsin. These investigators divided their subjects into groups on the basis of reported history of

occupational noise exposure. They obtained three experimental groups: (*a*) farmers (all farmers reported occupational noise exposure); (*b*) exposed nonfarmers; and (*c*) nonfarmers who denied occupational noise exposure. The thresholds for the three groups were not significantly different from each other, but the thresholds for each group over the frequency range from 3000 to 6000 Hz were poorer than those reported by Spoor (*9*) for males not exposed to occupational noise. These investigators suggested that all of their subjects may have incurred significant exposure to noise.

In our study, we obtained data on farmers as a part of an informational program conducted at the 1979 Missouri Farmers Association Agri-Fair. We also collected data on a smaller sample of nonfarmers who attended the Agri-Fair. Control data on central Missouri office workers were obtained as a part of the 1982 Shelter Insurance Health Fair, held in Columbia.

Procedures

Subjects. We are reporting data on male subjects who ranged in age from 25 to 64 years. The distribution of subjects in decade age groups is shown in table 1. The farmers (mean age = 43.6 years) were not differentiated with respect to type of farming but did represent all geographic regions of Missouri. The office workers (mean age = 42.1 years) were all employees of the Shelter Insurance Companies. The Agri-Fair nonfarmers (mean age = 43.5 years) were occupationally heterogeneous: friends and relatives of farmers (occupations undetermined), Missouri Farmers Association employees, policemen, safety exhibitors, mechanics, and so on.

All subjects volunteered for the hearing screening, and none was excluded on the basis of audiologic or otologic history. Each subject, though, was asked if he thought he had a hearing loss. Subjects at the Agri-Fair were tested when they visited the hearing conservation booth. Shelter Insurance employees volunteered at the hearing conservation booth at the company health fair or in response to a memorandum from the company nurse; testing was conducted several weeks later. To minimize the possibility that self-selection would result in a differential sampling bias among the experimental groups, we attempted to encourage participation in a similar manner for all subjects and provided a convenient service that required a minimum of waiting and testing time.

Audiometric Procedures. Fixed-level, pure-tone screening tests were conducted in each ear at three stimulus frequencies: 20 decibels (dB) hearing level (HL) at 1000 Hz, 20 dB HL at 2000 Hz, and 25 dB HL at 4000 Hz. Inability to hear one of these signals would indicate presence of a slight to mild hearing loss at that frequency.

The tests were conducted with two audiometers (Beltone, 10D and 12D), using standard earphones (Telephonics, TDH–39, mounted in MX–41/AR ear cushions). The audiometers were calibrated in accordance with the ANSI–1969 standard (*14*). Tests at the Agri-Fair were conducted in a sound-treated booth, mounted in a van, while those at Shelter Insurance were conducted in a quiet room. The background noise levels were sufficiently low so that the test signals were clearly audible to listeners with normal hearing.

Results

The percentages of hearing screening failures are shown in table 2 as a function of experimental group, age group, stimulus frequency, and ear (right or left). We have summarized this information in figure 1 by combining age groups and ears. Two trends are evident in the data in figure 1: (*a*) the rate of screening failures increased with stimulus frequency, and (*b*) at each stimulus frequency, the

Table 1. Number of farmers, office workers, and Agri-Fair nonfarmers surveyed, by age group, with mean years spent farming shown for farmers

Experimental groups	Age group (years)				All subjects (25–64)
	25–34	35–44	45–54	55–64	
Farmers	42	46	38	35	161
Mean years farming[1]	12.7	19.0	28.1	39.7	24.0
Office workers	36	44	27	22	129
Agri-Fair nonfarmers	23	16	19	17	75

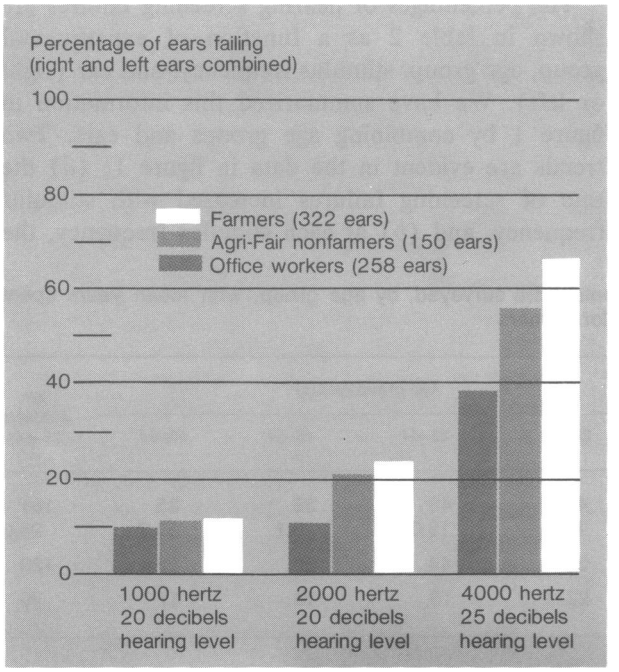
[1] Years below the age of 7 were not counted.

Table 2. Percentage distribution of hearing screening failures for farmers, office workers, and Agri-Fair nonfarmers as a function of stimulus frequency, ear, and age

Experimental group and condition	Ear	Age group (years) 25–34	35–44	45–54	55–64	All subjects (25–64)
Farmers:						
1000 Hz, 20 dB HL	R	11.9	6.5	15.8	22.9	13.7
	L	9.5	4.3	13.2	17.1	10.6
2000 Hz, 20 dB HL	R	9.5	17.4	34.2	40.0	24.2
	L	11.9	17.4	28.9	40.0	23.6
4000 Hz, 25 dB HL	R	33.3	56.6	76.3	91.4	62.7
	L	38.1	65.2	89.5	94.3	70.2
Office workers:						
1000 Hz, 20 dB HL	R	5.6	13.6	14.8	18.2	12.4
	L	2.8	4.5	7.4	18.2	7.0
2000 Hz, 20 dB HL	R	0.0	4.5	7.4	27.3	7.8
	L	5.6	9.1	11.1	31.8	12.4
4000 Hz, 25 dB HL	R	25.0	25.0	44.4	59.1	34.9
	L	30.6	34.1	51.9	68.2	42.6
Agri-Fair nonfarmers:						
1000 Hz, 20 dB HL	R	4.3	18.8	10.5	35.3	16.0
	L	0.0	6.2	10.5	17.6	8.0
2000 Hz, 20 dB HL	R	8.7	18.8	21.1	58.8	25.3
	L	0.0	12.5	5.3	52.9	16.0
4000 Hz, 20 dB HL	R	21.7	56.2	63.2	88.2	54.7
	L	13.0	62.5	68.4	100.0	57.3

NOTE: Hz hertz, dB decibels, HL hearing level, R right, L Left.

Figure 1. Hearing screening failures for farmers, Agri-Fair nonfarmers and office workers (ages 25 to 64) as a function of stimulus frequency

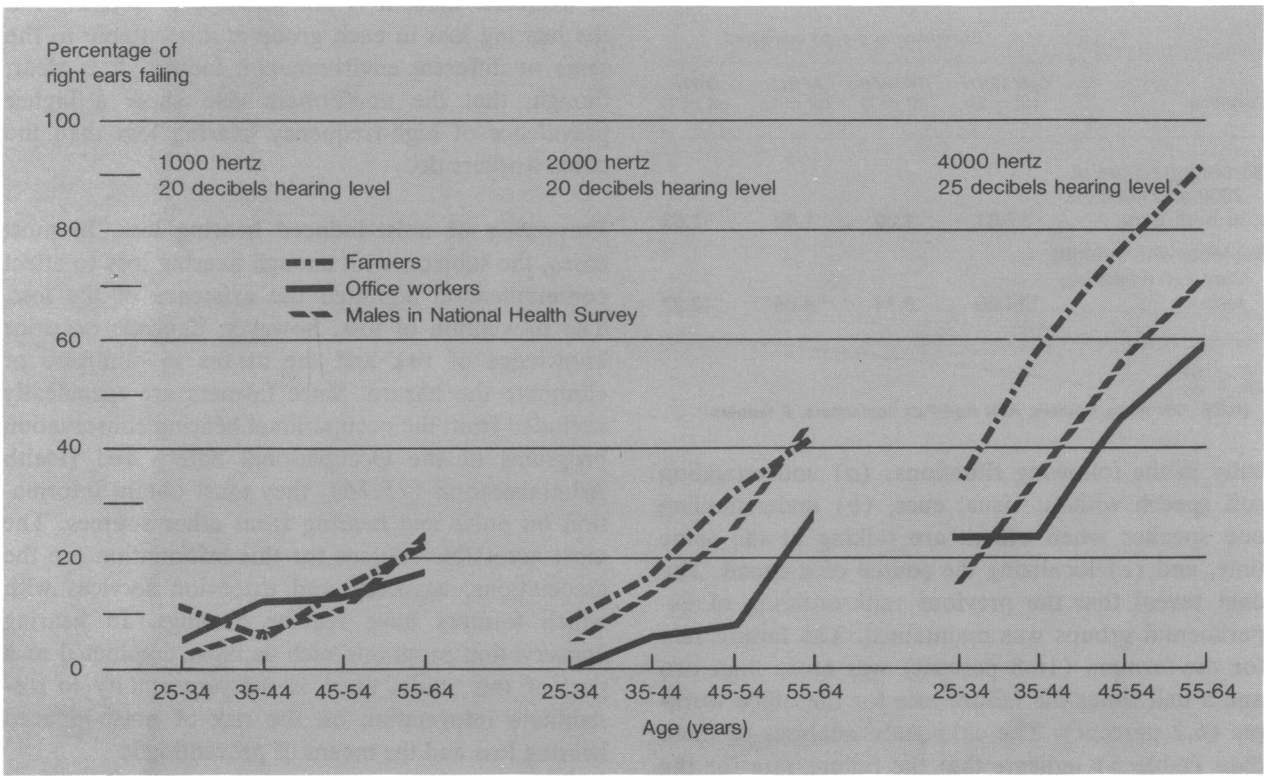


failure rate was lowest for office workers, intermediate for Agri-Fair nonfarmers, and highest for farmers.

Chi-square analyses (table 3) were performed to determine the conditions for which the experimental groups differed from each other. The analyses were performed for subjects throughout the age range of 25 to 64 years; analyses were not performed for subjects in individual age groups because of insufficient sample size. At 1000 Hz, the results for the three groups were not different. At both 2000 and 4000 Hz, the failure rate for farmers was significantly higher than that for office workers. In general, the results for the Agri-Fair nonfarmers were significantly poorer than those for the office workers and not significantly different from those for the farmers. The latter finding is similar to the findings of Karlovich and co-workers (*13*).

In figure 2, the data on hearing screening failures are shown as a function of age group. Right-ear data for the farmers and office workers are compared with right-ear data from the National Health Survey (*7*) for males in the general population. The prevalence of high-frequency hearing loss was lower among the office workers and higher among the

Figure 2. Hearing screening failures for farmers, office workers, and males in the general population (data from the National Health Survey)[1] as a function of stimulus frequency and age



[1]The NHS data at 4000 hertz were interpolated linearly.

Table 3. Chi-square values for comparisons of hearing screening results among office workers, Agri-Fair nonfarmers, and farmers as a function of stimulus frequency and ear

Test frequency	Ear	Experimental groups compared: OW/AFN/F (df = 2)	OW/AFN (df = 1)	AFN/F (df = 1)	OW/F (df = 1)
1000 Hz ...	R	.51	.51	.22	.10
	L	1.21	.07	.38	1.12
2000 Hz ...	R	[1]15.60	[1]12.02	.03	[1]13.83
	L	[2]6.34	.51	1.77	[2]5.92
4000 Hz ...	R	[1]22.68	[1]7.61	1.38	[1]22.21
	L	[1]22.30	[2]4.10	3.77	[1]22.30

[1] $P < .01$
[2] $P < .05$
NOTE: OW office workers, AFN Agri-Fair nonfarmers, F farmers

farmers than in the general population. One implication of these findings is that hearing in the general population is adversely affected by noise or other physical agents to which the office workers in this study were not subjected. We have used office workers as the control group to separate more clearly the effects of environment on hearing from the effects of aging.

In the data for right ears shown in figure 2 (as well as in the data for left ears shown in table 2) the failure rate was higher for the farmers than for the office workers at 2000 and 4000 Hz in every age group from 25 to 64 years. Thus, we conclude that the younger farmers as well as the older farmers are at risk for high-frequency hearing loss.

In table 4, results are shown for subjects who failed the hearing screening at 2000 and 4000 Hz in both ears. This measure was selected as an indicator of high-frequency hearing loss that would affect the ability to communicate. With this degree of loss, the listener would be expected to have diffi-

Table 4. Percentage of subjects failing the hearing screening at 2000 and 4000 Hz in both ears, and percentage of subjects who thought that they had a hearing loss

Condition	Office workers	Agri-Fair nonfarmers	Farmers
Screening failure at 2000 and 4000 Hz in both ears	6.2	10.7	16.8
Subjects who thought they had a hearing loss	26.4	32.0	47.2

Table 5. Chi-square analyses for data in table 4

Condition	Experimental groups compared			
	OW/AFN/F (df = 2)	OW/AFN (df = 1)	AFN/F (df = 1)	OW/F (df = 1)
Screening failure at 2000 and 4000 Hz in both ears	[1]7.81	1.30	1.50	[1]7.53
Subjects who thought they had a hearing loss	[1]14.30	0.74	[2]4.84	[1]13.22

[1] $P < .01$
[2] $P < .05$
NOTE: OW office workers, AFN Agri-Fair nonfarmers, F farmers

culty in the following situations: (*a*) understanding soft speech without visual cues, (*b*) understanding one speaker when others are talking at the same time, and (*c*) localizing the source of a sound. The data reveal that the previous rank-ordering of experimental groups was maintained. The failure rate for the farmers (16.8 percent) was more than two and a half times the failure rate for the office workers (6.2 percent). The chi-square analyses of these data (table 5) indicate that the failure rate for the farmers was significantly higher than that for the office workers and that the results for the Agri-Fair nonfarmers were not significantly different from those for the office workers or the farmers.

In the bottom half of table 4, results are shown for the self-evaluation of hearing loss. Thirty-seven percent of all subjects thought they had a loss. A substantial number of subjects who passed all parts of the hearing screening indicated that they thought they had a hearing loss. The results for the office workers and the Agri-Fair nonfarmers were not different from each other (table 5) but were different from those for the farmers.

Discussion

We found that, when compared with office workers, farmers are at risk for high-frequency hearing loss. In contrast to the results of Glorig and associates, our results showed that the risk is present for younger farmers as well as for older farmers. Among farmers from 25 to 64 years of age, 16.8 percent had a high-frequency loss that would affect communication, compared with 6.2 percent of the office workers.

Our data as well as those of Karlovich and coworkers indicate that the male nonfarmers with whom farmers associate have nearly the same prevalence of high-frequency hearing loss. On the basis of available data, it is not possible to determine if the hearing loss in each group is attributable to the same or different environmental factors. It is clear, though, that the nonfarmers also show a higher prevalence of high-frequency hearing loss than the office workers do.

Prevention of noise-induced hearing loss. In most cases, the subjects with enough hearing loss to affect communication admitted the existence of the loss. The prevention of loss, however, depends on prior knowledge of risk and the means to minimize or eliminate the hazard. Since farmers are specifically excluded from the occupational hearing conservation programs of the Occupational Safety and Health Administration (*15,16*), they must obtain information on noise and hearing from other sources. The most accessible sources for this information are the associations, agencies, and extension services with which farmers have regular dealings. In hearing conservation programs such as those conducted as a part of this study, there is the opportunity to disseminate information on the risk of noise-induced hearing loss and the means of preventing it.

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Increasing the Effectiveness of Community Workers Through Training of Spouses: A Family Planning Experiment in Guatemala

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SYNOPSIS

As community-based distribution (CBD) systems for the delivery of contraceptive methods are implemented in developing countries around the world, there is growing interest in making these programs more effective. Previous research on the CBD program in Guatemala indicated the importance of the role of the spouse: those community volunteers (called "distributors") who received assistance from their spouses were more effective in selling contraceptives than those who did not. The current experiment was designed to test the effect of providing the spouses of distributors with a formal 3-day training course on family planning and contraceptives. "Effect" was operationally measured in terms of the level of contraceptive sales. To this end sales data were compared for the experimental group (33 distributors whose spouses received the training) and the control group (33 distributors whose spouses wanted to attend the training but could not because their primary occupation did not allow them to be absent) for periods of 6 months prior to and 6 months following the training. The results indicate that sales among the experimental group increased significantly, whereas no such increase was found among the controls. This suggests a strategy for increasing the effectiveness of community volunteer workers that has received relatively little attention in the literature to date.

DURING THE 1970s the community-based distribution (CBD) of contraceptives emerged as an important alternative or supplement to the clinic-based delivery of family planning (FP) services in many developing countries. The basic objective of CBD programs is to make contraceptive services more readily accessible to the target population on a low-cost basis (*1*).

While there are variations by country, CBD programs generally operate through a network of community volunteers (male or female). These individuals, selected by the community, receive a short training course regarding FP, contraceptives, contraindications, and so forth. Subsequently they are supplied with contraceptives (pills, condoms, and vaginal spermicidals) which they sell at nominal cost or distribute free of charge from their homes or shops to members of the community. The work of the distributors is supervised periodically (often on a monthly basis) by program personnel. In most pro-